Cerner Corporation
(formerly DataMedic–Clinical Information Advantages, Inc.)

Coding and Storing Patient Information with MEDencode

Beginning in the 1980s, the demand for detailed patient information began to increase as clinicians sought more information in order to provide better patient care. Healthcare payers also wanted to gather more information so they could assess the effectiveness of patient care and better control costs. The primary source of patient information was the clinical note; however, important facts, such as the severity of a patient's illness, were often left out. To assist in gathering more complete patient information, Clinical Information Advantages, Inc. (CIAI), a clinical software company and subsidiary of DataMedic Corporation, proposed to adapt its existing notewriting technology to a knowledge-base-driven automated coding system. This system would make it easier for clinicians to generate detailed and complete clinical notes. CIAI believed that the new technology would significantly enhance the effectiveness of providers and, if widely adopted, could result in annual healthcare savings of $2 billion.

In 1994, DataMedic received an award from the Advanced Technology Program's (ATP) focused program, "Information Infrastructure for Healthcare," for a three-year project. Although the company was unable to incorporate the new technology into its electronic medical record product, CHARTstation, during the ATP-funded project, it successfully developed a software component called CHARTnote that could be used with CHARTstation, as well as with other products. CHARTnote utilizes MEDencode, a new technology developed over the course of the project, which automatically gathers, codifies, and records specific, detailed information about a patient.

By the end of the project in 1997, CIAI had successfully commercialized CHARTnote for gastrointestinal endoscopy. By 2000, thousands of clinicians were using the software to write clinical notes. In 2004, the company (now a division of Cerner Corporation) offered approximately seven CHARTstation products in different medical areas that incorporate the MEDencode technology. The ATP-funded project also resulted in several publications and presentations.

COMPOSITE PERFORMANCE SCORE
(based on a four star rating)
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Research and data for Status Report 94-04-0038 were collected during May – August 2004.

Clinicians and Healthcare Payers Seek More Complete Patient Information

Beginning in the early 1980s, both clinicians and healthcare payers sought more detailed patient information. Clinicians wanted more data on their patients' clinical histories so they could provide better care. Healthcare payers, such as health maintenance organizations, wanted more detailed information from clinicians about their patients and the outcomes of treatment so they could better manage costs. These data were being used to compare clinicians based on their costs, their compliance with practice guidelines, and the outcomes of their care. Payers could then make informed decisions about providers with whom to contract, provide information to patients and the public on the quality of care offered by providers, and assist providers in improving the quality of their care.

The clinical record, the primary source of patient information, was being used to evaluate provider performance. Yet, many records lacked the detail necessary to make a valid comparison of clinicians and the care they provided. It was determined that the primary reasons for this were the following:

- Significant patient information, such as the severity of a patient's illness, was not being recorded by clinicians.
- There was often reluctance on the part of clinicians to use the computer (especially those who felt comfortable using the dictaphone, which is a less structured means of recording patient notes).
- Many clinical information systems were capable of capturing only a limited amount of data.

MEDencode Technology Could Simplify Collection of Patient Information

Clinical Information Advantages, Inc. (CIAI), a subsidiary of DataMedic Corporation, designed and developed electronic medical record systems for clinical practices. The company wanted to assist clinicians by simplifying the process of collecting detailed patient information. CIAI proposed to develop technology called MEDencode that would automatically gather, codify, and record specific, detailed information about a patient. The information would be automatically saved in a computer-based patient record (CPR) during the clinical notewriting process. With the MEDencode technology, key terms such as symptoms and age would be captured in the CPR as the clinician completed it, leading to a diagnosis of the patient's condition and a descriptive report. At the same time, the coded data would be integrated into a database where it could later be accessed and used for research and analysis.

CIAI planned to incorporate this new technology into the notewriting feature of its CHARTstation products, which were electronic medical records for different medical specialties. The company would first incorporate MEDencode into its CHARTstation gastrointestinal (GI) endoscopy product, then it would develop MEDencode knowledge bases in other medical areas.

For a clinician who still wrote patient notes, using the new technology would minimize the effort required to collect relevant patient data. The technology would also be faster than traditional notewriting and data collection. It would also enable a clinician to access a completed patient record and search for and retrieve patient data more quickly than through traditional free-text notes. Moreover, CIAI estimated that a clinician using the new technology could reduce the time spent producing patient documentation by 38 percent. This valuable savings in time could potentially enable the clinician to see an additional patient each day, resulting in a 5-percent increase in that clinician's productivity.

Many medical records lacked the detail necessary to make a valid comparison of clinicians and the care they provided.

A clinician could also reduce administrative costs by avoiding transcription fees and the need to hire certified staff to code patient information for billing. Furthermore, these clinicians would benefit from reduced costs for chart retrieval, filing, and copying after they converted to the automated system. If the new technology were widely adopted, CIAI estimated the total annual savings could reach $2 billion.

CIAI Anticipates Greater Visibility of Patient Care

CIAI anticipated that the new automated coding system would result in a medical knowledge base from which extensive clinical data sets could be obtained. These data sets would be useful to companies that were developing provider-profiling products that are used to compare the activities of one or more healthcare providers and outcome measurement tools that demonstrate the efficacy of individual healthcare providers. The availability of inexpensive high-quality clinical data would allow these companies to remain focused on designing and developing data analysis tools, rather than on performing medical research. These developmental changes would benefit the provider and payer organizations that purchased and used the new data repositories and analysis tools.

Ultimately, however, the availability of detailed patient data through the MEDencode knowledge base would

result in greater visibility of patient care by both provider and payer organizations. It was theorized that this increased clarity would result in a deeper understanding of the components of high-quality, cost-effective healthcare delivery, which would lead to more standardized provisioning of patient treatment and care.

Development of MEDencode Technology Poses High Risk

CIAI understood that automating the collection and storage of clinical data as a byproduct of clinical notewriting was a high-risk endeavor. One major risk would be designing a medical repository without a standard data model. The company would address this, however, by conducting a well-structured trial of a codified repository for GI endoscopy, a domain that was well understood. A second major risk would be developing a system that could accurately correlate the nonstandard, narrative text entered by the clinician with standardized, codified clinical data.

Because the project risks were more than CIAI could assume, the company sought financial support. After applying to other programs, the company submitted a proposal to ATP and was awarded cost-shared funding in 1994 for a three-year project under ATP's focused program, "Information Infrastructure for Healthcare."

CIAI Successfully Develops MEDencode Technology

To achieve its goal of developing technology that would minimize the effort required to collect accurate and complete patient data during the clinical process and, as a byproduct, store the collected data in a knowledge base, CIAI would have to meet five technical objectives. These objectives and CIAI's results are summarized below:

- **Objective 1:** *Design and develop a healthcare data model (MEDdb) for the codified repository of a CPR and an intermediate codified representation using an object-attribute-value scheme for codification, with appropriate dictionary support*.
  Results: Met Objective—By the end of the ATP-funded project, CIAI had successfully developed a MEDencoded GI endoscopy knowledge base. This knowledge base was integrated into Endo Works, a product that supported GI endoscopy. Endo Works was manufactured by Olympus of America, the largest endoscopic manufacturer in the world.

- **Objective 2:** *Design and develop a knowledge base storage system for clinical objects that supports data collection, text generation, and posting of codified data to the repository*.
  Results: Met Objective—CIAI successfully developed a knowledge base storage system. In the process, the company made the decision to create separate value entries for each symptom, such as "weight loss" or "dysphagia" rather than "weight loss and dysphagia," so that a user could perform separate electronic searches for each term.

- **Objective 3:** *Design and develop domain analysis and knowledge base authoring tools for developing specialty-specific knowledge bases*.
  Results: Met Objective—By the end of the project, CIAI had developed tools that enable users to customize knowledge bases.

- **Objective 4:** *Design and develop a structured clinical note representation that can record the interaction with the knowledge base during the production of a note*.
  Results: Did Not Meet Objective—CIAI was unable to meet this objective with its current architecture. The company could not enhance the graphical user interface so that sections of a note could be independently recognized and manipulated. For example, neither the user nor the CIAI knowledge engineer could alter formatting in the text, such as fonts, indents, or bullets. However, the company planned to continue to work on this functionality and incorporate it in the next release of the software.

- **Objective 5:** *Design and develop a provider documentation engine that allows users to interact with the knowledge base in order to produce both a clinical note and codified data*.
  Results: Met Objective—Although CIAI originally planned to incorporate the new MEDencode technology into its existing CHARTstation

product line, it was unable to do so because the new technology had to be database independent. The company decided instead to build the notewriting engine for the MEDencode technology as a component that was separate from the rest of the CHARTstation code base. This component was called CHARTnote.

The field trial for the technology was conducted during the ATP-funded project at Brigham & Women's Hospital in Boston. During the trial, the CHARTnote engine successfully demonstrated that it could create narrative notes while simultaneously capturing clinical data.

CIAI Plans Several Applications of MEDencode Technology

During the ATP-funded project, CIAI began to make plans to incorporate the MEDencode technology into existing CIAI technologies. The company intended to integrate the technology into four of its existing CHARTstation reporting products: (1) GIstation for gastrointestinal endoscopy, (2) EMstation for emergency medicine, (3) EYEstation for ophthalmology office practice, and (4) RADstation for diagnostic radiology. At the same time, the company hoped to introduce a new product, FPstation, which is an electronic medical record management tool for family-practice medicine.

MEDencode would automatically gather, codify, and record specific, detailed information about a patient.

In the second year of the project, CIAI aimed to develop knowledge bases and reporting tools for additional specialty areas, such as internal medicine, pediatrics, and cardiology. Also, the company planned to develop a MEDencode toolkit and license it to development partners who could then build MEDencode-based products in other domains. CIAI would also provide training and support services to assist its partners in developing MEDencode-enabled products for their areas of the healthcare marketplace. CIAI planned to utilize a development and distribution strategy in which products for CIAI and the partners would be developed with the MEDencode technology and then distributed by market segment.

CIAI formed its first partnership during the ATP-funded project with Shared Medical Systems (SMS), a large company that at the time dominated the hospital information systems market. SMS offered to work with CIAI on codifying patient medical information (which corresponds to Technical Objective #5). Once the MEDencode technology was developed, SMS would integrate its enterprise-wide communications and repository capabilities with the MEDencode notewriting and data collection capability. The new technology would be placed in the front-end of SMS's workstations across all of its product lines. SMS would also provide CIAI with a distribution channel into the two major areas of physician clinical practice: hospital information systems and ambulatory care/group practice.

During the ATP-funded project, CIAI also began discussions with Olympus Corporation, the largest provider of fiber optic and video endoscopes in the world. CIAI met with Olympus to determine whether Olympus would distribute a MEDencode-enabled GIstation product to its established base of more than 2,000 endoscopy practices.

MEDencode Technology Is Commercialized

By the end of the project in December 1997, CIAI had successfully created CHARTnote as a separate software component for GI endoscopy and was licensing it to four key customers:

- Shared Medical Systems for its Novius product
- Olympus of America for its Endo Works product
- The Mayo Clinic
- The Central Region of the Veterans Administration (VA)

CIAI was also providing the software component to third parties who were interested in building their own CPR. By February 1998, Olympus's product Endo Works, which supported GI endoscopy, was commercialized with the new technology. Within the next few months, CIAI also added the MEDencode technology to its ophthalmology and oncology knowledge bases. At the same time, the company was collaborating with Health Technology Associates to use the MEDencode technology to create a powerful tool that would help firms monitor patient care and costs.

By 1999, CIAI had sold approximately 350 licenses for the new software. Its success also attracted another

company, InfoCure, a corporation that provides information management technology and services to dentists, orthodontists, and oral and maxillofacial surgeons. In November 1999, InfoCure acquired CIAI's parent DataMedic for $25.4 million in stock.

Thousands of clinicians were using the new software to write clinical notes by May 2000. Approximately 5,000 physicians were using the technology at more than 250 endoscopy sites and 100 primary care and emergency medicine sites. The number of products that contained the module also continued to increase.

By 2000, InfoCure had also developed additional knowledge bases and had seven CHARTstation products that incorporated the MEDencode technology on the market in the following areas:

- GI medicine
- Emergency medicine
- Internal medicine and family practice
- Outpatient ophthalmology
- Renal dialysis
- Rehabilitative medicine
- Oncology

In addition, Olympus's Endo Works product was being used at several hundred hospitals and ambulatory care centers. Sales of the product were increasing by 25 to 50 percent a year.

By 2001, with year-ending revenue of $107 million, InfoCure had earned $4 million in revenue from products incorporating the MEDencode technology. In 2004, the division of the company responsible for this technology was sold to Cerner Corporation.

ATP-Funded Project Results in Additional Public Benefits

Other potential large users of CIAI's technology were anticipating significant cost savings. The VA had selected the MEDencode technology for testing because it could be integrated into other software applications, was structured so that it could generate feasible billing codes, and could support several medical specialties. The VA anticipated that if it used the new technology, it could save up to several million dollars per year in each region in transcription fees and salaries for certified staff who perform billing coding.

In 2004, Brigham and Young Hospital received a large grant from the National Institutes of Health to perform research on patients diagnosed with colonic polyps based on data gathered through GIstation. The data collected through MEDencode-enabled technology have also been described in several professional papers.

Conclusion

With ATP's assistance, Clinical Information Advantages, Inc. (CIAI) developed a knowledge base driven automated coding system, which is a software component that makes it easier for a clinician to complete a computerized patient record (CPR). Through a series of knowledge base driven dynamic menus, key terms such as symptoms are incorporated in the CPR as the clinician completes it, resulting in a descriptive patient report. At the same time, the coded data are stored in a specialized database, where it is available for research and analysis.

Although the company was unable to incorporate the new technology into its existing notewriting technology, as it originally planned, it was able to develop a separate software component for gastrointestinal endoscopy, which it called CHARTnote. By the end of the ATP-funded project in 1997, CIAI had licensed CHARTnote to four of its major customers. The company was also providing CHARTnote to companies interested in building their own CPR.

In 1999, DataMedic (CIAI's parent company) was acquired by InfoCure, a corporation that provides information management and technology and services to dentists, orthodontists, and oral and maxillofacial surgeons. By 2000, thousands of clinicians were using the new software. InfoCure had also commercialized seven products in its CHARTstation line (electronic medical records for different medical specialties that incorporated the MEDencode technology). In 2001, InfoCure changed its name to VitalWorks, and in 2004 the division of Vitalworks responsible for this project was sold to Cerner Corporation. Since 1994, research on the ATP-funded technology has been shared through several presentations and publications.

PROJECT HIGHLIGHTS
Cerner Corporation
(formerly DataMedic–Clinical Information Advantages, Inc.)

Project Title: Coding and Storing Patient Information with MEDencode ("MEDencode" – A Technology to Populate a Clinical Data Repository as a By-product of Producing the Clinical Note)

Project: To support improved gathering of clinical information by developing tools that facilitate the production of clinical notes and, as a byproduct, gather the codified clinical data and store it in a database system.

Duration: 12/15/1994-12/14/1997
ATP Number: 94-04-0038

Funding (in thousands):

ATP Final Cost	$1,995	75%
Participant Final Cost	671	25%
Total	$2,666	

Accomplishments: With ATP funding, Cerner Corporation (formerly DataMedic–Clinical Information Advantages, Inc.) developed a software component that facilitates the production of clinical notes and, as a byproduct, gathers codified clinical data and stores it in a database system.

Commercialization Status: Since 1997, Cerner (formerly DataMedic–Clinical Information Advantages, Inc.) has successfully commercialized the ATP-funded technology. It has licensed it, provided it to companies interested in building their own computerized patient record, and packaged it with its own CHARTstation line of products (electronic medical records for different medical specialties).

By 2000, approximately 5,000 physicians were using the new software for clinical notewriting at more than 250 endoscopy sites and 100 primary care and emergency medicine sites. The number of products that incorporate the module has also continued to increase. By 2001, Cerner offered approximately seven CHARTstation products (electronic medical records) that incorporated the MEDencode technology and had earned $4 million in revenue.

Outlook: The outlook is positive for continued demand for Cerners' MEDencode-enabled CHARTnote products and licenses for the software component.

Composite Performance Score: ****

Number of Employees: 16 employees at project start, 55 as of December 1997

Focused Program: Information Infrastructure for Healthcare, 1994

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Publications:

- Starkweather, R.W., and R.S. Johannes. Advanced Electronic Medical Records for Cancer Cure. Toward an Electronic Patient Record-International Symposium Proceedings, 1998, San Antonio, TX, Waegemann, C.P., ed. Medical Records Institute, 1998.
- Kahane, S.N. "Multimedia Mobile Computer-based Patient Records–Stay Close to the Patient and Have It Your Way," Toward an Electronic Patient Record-International Symposium, Vol. 2, 269, 1996.
- Rucker, D.W., R.S. Johannes, S.W. Finley, and S.N. Kahane. "Designing an emergency medicine physician workstation to support risk management in decision making," Proc. of the American Medical Informatics Association Annual Fall Symposium, 787-91, 1996.
- Kahane, S.N. "Computerized Patient Records for the Continuum of Care Critical Technology for Managing Care & Measuring Outcomes," Toward an Electronic Patient Record-International Symposium, Vol. 2, 395-96, 1995.
- Kahane, S.N. "User Interface Technology for Computerized Patient Records Have it Your Way – Speech Recognition, Pen-Tablet and Voice Recording," Toward an Electronic Patient Record-International Symposium, Vol. 2, 343-51, 1995.
- Rucker, D.W., R.S. Johannes, S.W. Finley, and S.N. Kahane. "Aspects of Risk Management Support for an Emergency-Medicine Physician Workstation," Journal of the American Medical Informatics Association, 976, 1994.

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Cerner Corporation
(formerly DataMedic–Clinical Information Advantages, Inc.)

Presentations:

- Johannes, R. “From MEDencode to MEDassist,” ATP National Meeting, November 1999.

- Kahane, S.N. “Multimedia Mobile Computer-based Patient Records – Stay Close to the Patient and Have It Your Way,” Toward an Electronic Patient Record-International Symposium, San Diego, CA, May 1996.

- Rucker, D.W., R.S. Johannes, S.W. Finley, and S.N. Kahane. “Designing an emergency medicine physician workstation to support risk management in decision making,” American Medical Informatics Association Annual Fall Symposium, Washington, D.C., October 1996.

- Kahane, S.N. “Computerized Patient Records for the Continuum of Care Critical Technology for Managing Care & Measuring Outcomes,” Toward an Electronic Patient Record-International Symposium; Orlando, FL, March 1995.

- Kahane, S.N. “User Interface Technology for Computerized Patient Records Have it Your Way – Speech Recognition, Pen-Tablet and Voice Recording,” Toward an Electronic Patient Record-International Symposium; Orlando, FL, March 1995.